Preface

INTRODUCTION

Advances in Applied Geospatial Research

Applied geographers continue to embrace Geospatial Information Science and Technologies (GIS&T) within their research methodologies. No longer are geospatial technologies, spatial analytic techniques and modeling, and geovisualization the novelty of decades past but standard instruments of the proverbial geographer’s toolbox. This volume, titled *Emerging Methods and Multidisciplinary Applications in Geospatial Research* (EMMAGR), is a compendium of peer-review studies reprinted from Volume 2 (2011) of the *International Journal of Applied Geospatial Research* (IJAGR). Having gone through a double-blind peer-review process, the studies herein have received our “stamp” of approval. Therefore, it is with much gratitude to all contributing authors, editorial board members, guest editors, and especially reviewers that we offer EMMAGR (Albert, 2010a, 2010b, 2011a, 2011b, 2011c; Dobbs & Ruvane, 2011; Granell & Lemmens, 2011).

EMMAGR is organized into four sections, each bearing the imprint of one or more recognized experts. Section 1 focuses on Historical Geographic Information Systems (HGIS) and owes its impetus to G. Rebecca Dobbs and Mary B. Ruvane from the University of North Carolina at Chapel Hill. Their perspective on the “Past Informing the Future: Applied Geospatial Solutions” inspired Chapters 1-6.

Section 2, “Emerging Methods in Applied Geospatial Research,” appears under the editorial oversight of Dr. Jay Lee, Professor of Geography in the Department of Geography at Kent State University, and Executive Director of the Applied Geography Conferences, Inc. Chapters 7-12, therefore, highlight emerging and sophisticated methodologies underpinning contemporary studies in applied geospatial research.

Dr. Nairne Cameron, Assistant Professor of Geography at Algoma University and past Chair of the Applied Geography Specialty Group (AGSG) of the Association of American Geographers (AAG), spearheaded Section 3. This section is titled “Teaching, Learning, and Geospatial Facilities and Resources” and includes Chapters 13-17. The AGSG is a vibrant organization and sponsors the Anderson Medal, a student paper competition, and a class exercise award competition, along with numerous other activities. The scholarly contributions from a single year of AGSG activities could easily fill this entire volume. The editors, therefore, are indebted to Dr. Cameron for facilitating this showcase of selected AGSG accomplishments.

The last section (4), titled “Service Training in Global Earth Observation System of Systems,” no less than the previous three, is the recipient of expert guidance from Carlos Granell and Rob Lemmens. Carlos Granell received his PhD in Computer Science from the Universitat Jaume I (Spain) in 2006 and
is with the Institute for Environment and Sustainability, European Commission, Joint Research Centre, Ispra, Italy. His research interests stem from a broad effort in integrating geoprocessing services, workflow, and the composition and reuse of geospatial services in Spatial Data Infrastructure (SDI) and GEOSS settings. Rob Lemmens is an Assistant Professor of Applied Computer Science in the Department of Geo-Information Processing at ITC, since 1998. He holds a PhD in Geoinformatics from Delft University of Technology. His research focuses on Internet GIS, mobile GIS, and semantic modeling of distributed geo-information services in spatial data infrastructures. Chapters 18-22 offer applied geographers a glimpse under the “hood” to see the inner machinations of geoprocessing. Seeing the complexities and challenges of geoprocessing may encourage applied geographers to better appreciate the role of computer scientists to GIS&T.

SECTION 1: PAST INFORMING THE FUTURE – APPLIED GEOSPATIAL SOLUTIONS

Geospatial technologies were first used to investigate or reconstruct the past in the early 1990s, and the approach gained ground through the late 1990s and 2000s, as represented in a number of books and special issues (Bailey & Schick, 2009; Bodenhamer, et al., 2010; Ellis & Bodenhamer, 2009; Ellis & Gregory, 2001; Gregory, 2003; Gregory & Ellis, 2007; Knowles 2000, 2002, 2005, 2008b). While large, high profile projects continue to be of tremendous importance in this “interdisciplinary subfield” (Knowles, 2008a, p. 7), smaller projects carried out by individuals and small teams now appear in a wide range of publications, and authors need no longer devote valuable page space to justifying the decision to employ historical GIS.

The emphasis in most previous collections of historical GIS work has been on the disciplines of history and/or geography, and on academic research or public spatial history or infrastructure projects. In contrast, this collection is focused on applied research, work that contributes knowledge or understanding with the potential to inform practical decision-making activities in today’s world through illuminating the past. Such applied work might introduce new understandings of present landscapes for planners and preservationists but also for the general public; alter understandings of key events, landscape features, or places; make visible the previously hidden roles or experiences of marginalized groups; produce new pedagogical possibilities; or enhance spatially oriented access to sources from the past.

A vibrant diversity of work on the past is being done with GIS and related technologies and information structures. The potential breakthroughs enabled by the use of GIS to study the past are being embraced across a diverse population of investigators, in and out of the academy and with many perspectives on how the past can be studied. Arguably, it is time to call historical GIS not just interdisciplinary, not just a “subfield of history” (to complete the Knowles quote above, from Knowles, 2008a, p. 7), not just a “young subdiscipline” (Bodenhamer, 2010, p. 22), but an interdisciplinary in its own right. Similarly to the way geography is often visualized with a Venn diagram in which the subfields of geography are formed at the intersection of geography with numerous other disciplines, historical GIS may be conceptualized as occupying the “space between” various disciplines through which the past is studied. Researchers might then have one foot in their own disciplines and one in the interdisciplinary that is historical GIS.

When the advantages that historical GIS confers are integrated into a wide range of endeavors, in the space of interdisciplinary, this integration potentially transforms the work of individual disciplines to
stimulate substantive breakthroughs and create new knowledge which in turn impacts those individual disciplines. Just such an iterative process is evident in several of the chapters in this section. A case in point is the work of Brister, Hane, and Korfmacher. This interdisciplinary team (philosophy, biology, and environmental science) demonstrates in Chapter 1 the utility of historical GIS in reconstructing ecologies of the past, using a series of surveyors’ records from the early 19th century to map tree species communities, soil conditions, and evidence of wetland areas in the so-called Connecticut Tract in western New York. Not surprisingly, they found considerable change, but also some continuity. As they argue, better restoration and management plans, understanding of long-term causes of change, and understanding of natural and cultural causes of ecosystem variability can all result from historical ecology reconstruction.

In Chapter 2, the work of Algeo, Epperson, and Brunt, a geographer and two geoscientists, respectively, on Mammoth Cave National Park in Kentucky, addresses multiple fronts. At one level, this project looks at the politics of park creation and the way in which a settled rural landscape was transformed into a “wilderness” through deliberate government action. At another level, it employs microscale historical geography techniques (including GIS) and a variety of sources to match historical people (and thus indirectly their descendants) to their lost homes on park lands. Lastly, the team has created a public participation historical GIS that helps people find their families’ past places, and facilitates an increase in the materials of memory through public contributions to the GIS. The work has a direct effect on a certain population of people through the agency of public memory, and an indirect effect in that it uncovers a previously hidden history of settlement, dispossession, and social construction of wilderness.

Towers, a geographer, has developed an innovative approach to historical dasymetric mapping, through his work on Appalachian communities in West Virginia. In previously published work (2010), using both terrain analysis and historical map evidence, Towers developed a technique to delineate the extents of historical communities. In Chapter 3, he builds on that work by laying out a methodology for dasymetric mapping that conforms to the cultural spaces of lived community rather than the lines of census geography, which often cut through communities. Needless to say, the technique Towers introduces here has the potential to transform dasymetric mapping not only historically but in present landscapes as well.

The fourth chapter in this section represents a type of geospatial analysis that is seldom found among more humanities-oriented historical GIS projects. Dean, a geospatial scientist, has used Monte Carlo simulation to analyze potential viewsheds from the Japanese planes searching for the American ships before the start of the Battle of Midway. His work incorporates a construction of viewsheds that is quite different from that used, for instance, by Knowles (2008c) in her work on what Lee could see at Gettysburg, or in Randle’s (2011) exploration of the panopticon concept in slavery-based plantations. Instead of the view being constrained by terrain, in Dean’s model it is constrained by a suite of factors such as distance, angle, speed of ship and plane, and cloud cover. The results of Dean’s project add to the body of understanding about the outcomes of Midway, and have relevance in the present military as well, in the sense that visually locating moving objects in the field remains a concern.

The chapter by Norder and Carroll, both anthropologists, also employs Monte Carlo simulation, though for a different purpose and in conjunction with other types of spatial analysis. The chapter examines indigenous rock art in the Lake of the Woods region of Canada, and compares actual locations of pictographs with the universe of similar locations, which could have pictographs but do not. Through a range of spatial and statistical techniques, perhaps most effectively least cost path analysis, they connect pictograph locations with probable routes of travel by the Indians of the area in the past (and in some cases the present). The work not only adds to the understanding of rock art and its purposes, but also potentially contributes to preservation of rock art at a time when various forces are hastening its demise.
The sixth and final chapter in this section engages with a very different part of our hypothetical Venn diagram. Siabato, Fernández-Wyttenbach, and Bernabé-Poveda, all with GIS and land surveying backgrounds among other talents, present work at the intersection of humanities, computing, information science, and historical cartography. The tool they have developed enables researchers to view early maps in virtual geographic space. Their Virtual Map Room does not store the digitized maps, but draws upon georeferenced images and metadata in libraries around the world, and also incorporates some analysis tools. Developed in conjunction with major European research projects, such as DynCoopNet, this tool has the potential to aid researchers broadly.

Historical GIS, as demonstrated in these chapters, interfaces with many ways to study the past and draws from the many disciplines that surround its “space between.” Using the gamut of GIS techniques, historical GIS is producing insights and understandings, which can be applied to the business of bettering environments, educations, lives.

SECTION 2: EMERGING METHODS IN APPLIED GEOSPATIAL RESEARCH

This section of Emerging Methods and Multidisciplinary Applications in Geospatial Research includes four chapters (7-10) that emerged from expanded papers presented at the 32nd Annual Applied Geography Conference (AGC). The 32nd Applied Geography Conference convened at the Sheraton Baton Rouge Convention Hotel from October 28-31, 2009, in Baton Rouge, Louisiana. According to the AGC’s (2009) homepage:

The Applied Geography Conferences have provided a forum for the exchange and critique of ideas related to the application of geographic concepts, analytical techniques, data, and methods since 1978. The conference brings together practitioners, academicians, and other professionals who seek geographic solutions and explanations to societal problems. Attendance ranges between 250 and 400 people. This size meeting offers an ideal setting for new professional geographers and students to gain public speaking experience and share ideas with geographers from business, government agencies, and academic institutions. In addition to paper sessions, the Conference also features exhibits, student poster presentations, field trips, special events, and selected papers are peer-reviewed and published in the Papers of Applied Geography Conferences.

Dr. Jay Lee is the executive director of the Applied Geography Conferences and a Professor and past Chair of the Department of Geography at Kent State University in Kent, Ohio, U.S.A. His research interests involve modeling geographic patterns of urban life (urban sprawl, public health, crime, air pollution, etc.) through time and space (Albert, 2011c). Dr. Lee provided the editorial oversight for Comer, Graham, and Brown’s “Relating Transportation Quality Indicators to Economic Conditions in South-Central U.S.” (Chapter 7), Lu, Morgan, and Allen’s “A Neural Network for Modeling Multicategorical Parcel Use Change” (Chapter 8), Dugas, Demers, Greenlee, Whitford, and Patterson’s “Rapid Evaluation of Arid Lands (REAL): A Methodology” (Chapter 9), and Dolney’s “A GIS Methodology for Assessing the Safety Hazards of Abandoned Mine Lands (AMLs): Application to the State of Pennsylvania” (Chapter 10).
This section focuses on a range of geospatial techniques while highlighting a diverse set of study sites including: Arkansas, Kansas, Oklahoma, and Texas; Beaufort County, South Carolina; New Mexico, Pennsylvania; and four counties encompassing the Detroit Metropolitan Area.

Comer et al. (Chapter 7) employ Geographically Weighted Regression (GWR) to assess the relationship between transportation infrastructure and economic conditions. GWR incorporates Tobler’s (1970) first law of geography stating that, “Everything is related to everything else, but near things are more related than distant things” (Tobler, 1970).

In Chapter 8, Lu, Morgan, and Allen use Artificial Neural Network (ANN) to model and predict parcel changes. Their results showed that ANN outperforms numerous other land cover/land use models currently available.

Dugas et al. (Chapter 9) at New Mexico State University developed REAL (Rapid Evaluation of Arid Lands), a cost-effective approach for delineating plant communities in arid environments. REAL incorporates low-tech methods with expert opinion to expedite land cover assessment. This simple approach recognizes practical constraints that land managers face such as the availability of hardware, software, and specialized personnel while benefiting from the speed REAL offers.

Dolney (Chapter 10) uses focal statistics and functions (i.e., focalvariety, focalmax) to assess the safety hazards of Abandoned Mine Lands (AMLs) in Pennsylvania. Focal statistics use an input raster and a specified neighbor (kernel) to calculate focal functions to an output raster. Dolney contends this is a cost-effect approach for updating safety hazards priorities of AML as land use and population change. Like REAL (Chapter 9), Dolney offers another cost-saving and expedient approach to spatial analysis.

Using volunteered geographic information of 2,497 dead birds (Corvidae) from four counties encompassing Detroit, Michigan, McKnight et al. (Chapter 11) exercised disease modeling, spatial statistics (Moran’s I, Local Indicators of Spatial Association [LISA], and Geographic Analysis Machine) to discuss the implications of using volunteered geographic health data to identify hot spots of West Nile Virus.

Garrison’s “Anderson Distinguished Lecture,” delivered in San Francisco in 2007 at the Annual Meeting of the Association of American Geographers, closes out this section on Emerging Methods in Applied Geospatial Research (Chapter 12). The Anderson Lecture is also an Applied Geography Specialty Group sponsored activity, and appears here through the coordinating efforts of Dr. Barry Wellar of the University of Ottawa with Anderson Medal recipient William Garrison of the University of California at Berkeley, and lecture panel members Ross Mackinnon, University of Connecticut; William Black, Indiana University; and Arthur Getis, San Diego State University. As one of the forerunners of the Quantitative Revolution in geography, Garrison shares decades of experiences with “Increasing the flexibility of legacy systems.” Dr. Garrison continues to inspire up-and-coming geographers exploring emerging methods in geospatial research.

SECTION 3: TEACHING, LEARNING, AND GEOSPATIAL FACILITIES AND RESOURCES

The Applied Geography Specialty Group (AGSG) has an ongoing interest in promoting teaching and learning. The AGSG is one of over sixty specialty and affinity groups nested within the Association of American Geographers (AAG). The AGSG is one of the AAG’s most vibrant specialty groups and certainly accomplishes its stated purpose (AAG, 2012):
The Applied Geography Specialty Group aims to increase the visibility of applied geography in the profession and the general population and facilitate communications among the Group members; promote and recognize individual excellence in applied geographic research.

No less than four out of twenty-one chapters of this volume (Chapter 12—Garrsion et al. in Section 2, Chapter 13—Cameron, Chapter 14—Hawthorne, and Chapter 15—Vogt in Section 3) emerged from AGSG sponsored activities via the coordination of Dr. Nairne Cameron, past chair of the AGSG.

Cameron begins this section with a synopsis of Applied Geography Specialty Group (AGSG) activities and accomplishments over the 2009-2010 academic calendar (Chapter 13), including the recognition of board officers and members, award recipients of its student paper competition, two class exercise competitions, and other awards (Anderson Medal, Citation Award, and Praxis Award). Herein, Cameron summarizes the numerous paper and panel sessions, including the prestigious Anderson Lecture, AGSG sponsored at the AAG 2010 Annual Meeting in Washington, DC. Here, she also points out the collaborative initiatives between the AGSG and the Applied Geography Conferences (AGC), another important organization for applied geographers in the United States and Canada. There exists a strong spirit of cooperation between the AGSG and the AGC and comradeship between its overlapping memberships.

Chapters 14 and 15 are winning entries, respectively, from the December 2009 and June 2010 Class Exercise Competitions sponsored by the Applied Geography Specialty Group. Hawthorne (Chapter 14) was the first winner of the Class Exercise Award Competition in December 2009 with a capstone project linking cartography with service learning. Students worked with community leaders to solicit input for the development of map brochures highlighting public service information such as the locations of after-school activities, stores selling fresh fruits and vegetables, and historic sites in the local area. This capstone project introduces students to the idea of participatory endeavors in geography (i.e., participatory GIS) and offers them real-world experience while enlightening the community leaders and the general public of the value of a geographic perspective. Vogt (Chapter 15) describes another capstone project for undergraduate students, this one built around remote sensing, titled “Colorado 14ers, Pixel by Pixel.” Vogt was the second winner (June, 2010) of the AGSG’s Class Exercise Award Competition. Entries for this competition must include the following items: abstract, exercise handouts, a narrative of the exercise, and five to ten slides overviewing the exercise. These winning entries were re-packaged in the format of an academic manuscript under the direction of Donald Albert, editor-in-chief of the International Journal of Applied Geospatial Research, and are reprinted herein.

The next chapter (16) by Rick Bunch, Anna Tapp, and Prasad Pathak, “Leveraging the Science of Geographic Information Systems,” highlights a thriving entrepreneurial university approach at the Center for Geographic Information Science at the University of North Carolina at Greensboro. Bunch et al. explain how contractual work supports the funding of staff and graduate students while also facilitating faculty research. In the era of tight budgets and resources, the entrepreneurial university offers a glimmer of financial independence.

Finally, Steven Young shares a novel application of remote sensing images—art. Dr. Young’s pieces have appeared in major venues in the United States and overseas. Manipulating remotely sensing data to produce art is an ingenious method of teaching geospatial technologies in introductory geography courses, and a “hook” to capture students’ attention.
SECTION 4: SERVICE TRAINING IN GLOBAL EARTH OBSERVATION SYSTEM OF SYSTEMS (GEOSS)

The Group on Earth Observations (GEO), a voluntary partnership of governments and international organizations, is developing the Global Earth Observation System of Systems (GEOSS). The purpose of GEOSS is to coordinate existing Earth Observation Systems by supporting their interoperability, sharing information, reaching a common understanding of user requirements, and improving delivery of information derived from observations to users. GEOSS is simultaneously addressing nine societal benefit areas for critical importance to our planet: disasters, health, energy, climate, water, weather, ecosystem, agriculture, and biodiversity (Granell & Lemmens, 2011).

To achieve the goal of sustainable development, GEOSS requires the integration of a vast amount of disparate and heterogeneous data and resources from local to global levels. Apart from other essential ingredients for the success of GEOSS, such as interoperability and the use of standards, geoprocessing workflow and geospatial service chaining provide flexible means of processing highly distributed and complex data for a wide variety of uses and scenarios across the nine societal areas.

This section of the EMMAGR includes four chapters on service chaining in GEOSS. Chapter 18 (Giuliani et al.) titled “Sharing Environmental Data through GEOSS” discusses and exposes the challenges for GEOSS as a promising and powerful framework to share environmental data and build processing capabilities to support the achievement for sustainability development initiatives. As GEOSS is increasingly compiling a great amount of federated, disparate geospatial services and data across domain and community boundaries, Chapter 19, (Fitzner) titled “Formalizing Cross-Parameter Conditions for Geoprocessing Service Chain Validation,” deals with the need to perform semantic mediation between the concepts and vocabularies brought into process descriptions for geoprocessing operations, and formalizes cross-parameter conditions based in a rule-based language. Chapter 20, (Epelbaum et al.) titled “Target Evaluation and Correlation Method (TECM) as an Assessment Approach to Global Earth Observation System of Systems (GEOSS),” proposes an assessment and correlation approach of GEOSS across the nine societal benefit areas. Building on the Systems of Systems characteristics, the TECM method aims to provide a quantitative method to evaluate the GEOSS Targets, to identify synergies, and to advise about future developments of GEOSS.

Together, Chapters 18-20 represent ongoing efforts to operationalize access to Earth observation data that ultimately serves a variety of users such as the Columbia Regional Geospatial Center System described by Blackwell and McDonald in Chapter 21. The electrical and industrial engineers, computer scientists, geoinformatic specialists, and other contributing specialties are devising innovative methods of distributed processes that use service-oriented architectures for accessing the huge volume of sensors, satellite imagery, and spatial data.

At the same time, we should observe that the challenges of GEOSS have just started. We expect new innovations and efforts in the near future towards a System of Systems that links and integrates environmental, Earth Observations, socio-economic, and institutional resources worldwide, and will lead to the improvement of societal welfare (Granell & Lemmens, 2011).
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REFERENCES


**ENDNOTE**

1 Although it is difficult, if not impossible, to locate a simple definition for this term, it is clearly a noun and thus in marked contrast to “interdisciplinary” (see Stycos, 1989, p. vii, for a possible first use of the word). As such, the field of inquiry or practice so referenced is substantive, made up of constituent parts that come from other disciplines, but not “sub” to them. McCarty (1999) applied the term to humanities computing in a seminar on “Is Humanities Computing a Discipline?”